Executive Summary

The National Assessment

This report presents the results of a National Assessment Workshop held in August 1998 to address the problem of estuarine eutrophication. The assessment was based primarily on the results of the National Estuarine Eutrophication Survey, conducted by NOAA from 1992 to 1997, but was supplemented by information on nutrient inputs, population projections, and land use drawn from a variety of sources. It covers 138 estuaries, representing over 90 percent of the estuarine surface area of the coterminous United States, plus the Mississippi River Plume. The final assessment presented here was undertaken at the National Assessment Workshop by a select group of experts, all of whom participated in the eutrophication survey. The Workshop was structured around answering seven key questions regarding the severity and extent of eutrophication in the nation's estuaries. All results presented in this report were reviewed by the Workshop participants.

About Estuarine Eutrophication

Eutrophication is the accelerated production of organic matter, particularly algae, in a water body. It is usually caused by an increase in the amount of nutrients being discharged to the water body. As a result of accelerated algal production, a variety of impacts may occur, including nuisance and toxic algal blooms, depleted dissolved oxygen, and loss of submerged aquatic vegetation. These impacts are interrelated and usually viewed as having a negative effect on water quality and ecosystem health. Eutrophication has been recognized as a problem in freshwater systems for many years, but only in the past three decades has concern grown about the widespread occurrence of eutrophic conditions in estuarine systems. Due to the complexity of the phenomena and the lack of consistent national data sets, the severity and extent of the problem had never been adequately characterized at the national scale.

Key Questions

1. **What are the severity and extent of eutrophic conditions exhibited within the estuaries of the United States?**
2. **To what extent are eutrophic conditions in the nation's estuaries caused by human activities?**
3. **To what extent do eutrophic conditions impair the use of estuarine resources, and what are the important impaired uses?**
4. **Where should management efforts be targeted to achieve the greatest benefit toward remediation and protection from degradation?**
5. **To what extent can the severity and extent of eutrophic conditions be expected to increase by the year 2020, given the natural susceptibility of estuaries and the potential for increasing nutrient inputs?**
6. **Which data gaps and research and monitoring needs are most critical in terms of improving the ability to assess and respond to eutrophication symptoms?**
7. **How can the results of this assessment be translated into a national strategy?**

Key Findings

1 Eutrophication Severity and Extent

Symptoms of eutrophication are prevalent in the nation's estuaries.

- High expressions of eutrophic conditions are exhibited in 44 estuaries, representing 40% of the total estuarine surface area studied. An additional 40 estuaries exhibit moderate conditions. When considered together, the estuaries with moderate to high conditions represent 65% of estuarine surface area in the study.
- High conditions occur in estuaries along all coasts, but are most prevalent in estuaries along the Gulf of Mexico and Middle Atlantic coasts.
- 82 estuaries, representing 67% of estuarine surface area, exhibit moderate to high expressions of at least one of the following symptoms: depleted dissolved oxygen, loss of submerged vegetation, and nuisance/toxic algal blooms.

Assessment Data: National Estuarine Eutrophication Survey

Description: rigorous multi-year effort to synthesize the best available information about eutrophic conditions

Characteristics:

- consistent and comparable national data set was produced through survey of over 300 estuarine scientists and managers
- includes spatial and temporal information about eutrophication symptoms, including chlorophyll *a*, macroalgae, epiphytes, dissolved oxygen, submerged aquatic vegetation, and nuisance/toxic algae
- survey data aggregated by estuary and final results reviewed by experts at the Assessment Workshop
- collection, evaluation, and review of the survey data was most rigorous of all evaluations in the National Assessment

2 Human Influence on Eutrophication

Human influence on the expression of eutrophic conditions is substantial.

- A high level of human influence is associated with a majority (36) of the 44 estuaries with high eutrophic conditions.
- Only six (14%) of the 44 estuaries with high-level eutrophic conditions have corresponding high-level nitrogen inputs. An additional 22 of the 44 estuaries have moderate-level nitrogen inputs.
- Of the 44 estuaries with high-level eutrophic conditions, more than half (25) exhibit a high susceptibility to retaining nutrients.

Assessment Data:

- Watershed monitoring data from the U.S. Geological Survey provided first-order estimates of nitrogen inputs.
- U.S. Census Bureau population estimates and Department of Agriculture Agricultural Census data were used as potential nutrient pressure indicators.
- Estuarine susceptibility was determined using NOAA data on freshwater inflow, tide, and estuarine geometry.

Description: provides estimates of human-related nutrient inputs, estuarine susceptibility, and human influence

Characteristics: assessment based on data less rigorously evaluated and reviewed than for eutrophic conditions

3 Impaired Uses of Estuaries

Impairments to estuarine resources, and fisheries in particular, are of great concern.

- 69 estuaries were identified by workshop participants as having human-use impairments related to eutrophication.
- Compared to other impaired uses, commercial/recreational fishing and shellfisheries were identified as impaired for human use in the greatest number of estuaries, 43 and 46, respectively.

Assessment Data: expert evaluations at Workshop

Description: Experts identified impaired uses they judged to be related to estuarine eutrophic conditions.

Characteristics: Although the information is not supported by a comprehensive national data set, it does provide a rough insight into the extent of problems stemming from eutrophic conditions.

4 Potential Management Concerns

Management requirements are dependent on eutrophic conditions and susceptibility.

- The 23 estuaries with high expressions of eutrophic conditions and high susceptibility are likely to require greater management effort and longer response time for results than those estuaries with low susceptibility. These estuaries represent approximately 10% of the national estuarine surface area.
- There are 10 estuaries that have low eutrophic conditions and high susceptibility; accordingly, they should be priorities for preventive management. These estuaries represent approximately 3% of the national estuarine surface area.
- All of the typical point and nonpoint pollution sources were identified at the Workshop as important to target in order to manage nutrient problems. However, there are some important regional differences in nutrient sources, such as combined sewer overflows in the North Atlantic.

Assessment Data: NOAA susceptibility and Eutrophication Survey data plus expert evaluations at Workshop

Description: In addition to evaluating eutrophic conditions and susceptibility (see numbers 1 and 2), experts identified pollution sources important for managing nutrient inputs in each watershed.

Characteristics: Although the pollutant source information is not based on a comprehensive national data set, the expert evaluation of important point and nonpoint sources is useful for gaining a first-order understanding at the national level of the types of actions, and the level of effort, that will be required to address the problem.

5 Future Eutrophic Conditions

Without preventive efforts, eutrophic conditions can be expected to continually worsen.

- Eutrophic conditions will most likely worsen in 86 estuaries by the year 2020.
- Of the 86 estuaries expected to worsen, 43 exhibit only low to moderate eutrophic conditions.
- The 10 estuaries that exhibit low eutrophic conditions and have high susceptibility are most at risk of future degradation if human-related nutrient inputs increase.

Assessment Data: projected population growth estimates adapted from the U.S. Census Bureau and NOAA susceptibility data

Description: Experts at the National Workshop used population growth and estuarine susceptibility estimates, along with their knowledge of the estuarine watersheds, to project the direction and magnitude of change in current eutrophic conditions.

Characteristics: The reliability of this information is inherently vulnerable to unforeseen changes in input levels from nutrient pollution sources.

6 Data Gaps and Research Needs

Much remains to be done to better characterize and understand estuarine eutrophication.

- Given all of the monitoring and research done to date, information and knowledge is still inadequate in 48 estuaries (low confidence or inadequate data for assessment). These estuaries represent approximately 25% of the nation's estuarine surface area.
- All participants in the National Assessment process agreed that research is needed to clarify the linkages between eutrophication and impacts on estuarine resources, including fisheries, recreation and tourism, and risks to human health.

Assessment Data: expert experience and knowledge, in combination with data completeness and reliability analysis of the Eutrophication Survey results

Description: Experts at the National Assessment Workshop identified data gaps and research needed to improve the assessment of the severity human influence, impacts, and appropriate responses to eutrophication problems in estuaries.

Key Findings, continued

6 Data Gaps and Research Needs, continued

- The National Assessment process confirms that much remains to be done to adequately characterize nutrient pressure on estuaries. Better quantification is needed of total nutrient inputs, inputs by source, and estimators of nutrient pressure (e.g., population, land use). Atmospheric and groundwater inputs are least well quantified.
- Better characterization of physical factors is needed, including basic circulation patterns, effects of weather patterns, climate change, changing land use, and resultant effects on nutrient delivery, circulation, and eutrophic conditions.
- Other research needs include defining the relationship between nutrient inputs and toxic blooms, better characterization of assimilative capacity, and characterization of the effects of seasonal population changes.

7 Toward A National Strategy

Assessment results will be valuable in setting national priorities.

- A national strategy, which incorporates the results of this assessment, should be developed to help set priorities and support decision-making at the national level.
- The strategy should focus on management, monitoring, and research, and should effectively integrate with regional, state, and local programs.
- For estuaries in serious condition, priorities should focus on management action; for those in less serious condition but at risk, the focus should be on monitoring and prevention.
- Estuaries for which there is insufficient information for evaluation should undergo basic monitoring and assessment activities.

Assessment Data: expert experience and knowledge base

Description: These recommendations were developed at the National Assessment Workshop from facilitated discussions with the participating estuarine eutrophication experts.